WHAT IS CLAIMED IS:

1. A system for detecting a signal, comprising:

a receiver for receiving a wideband signal to be processed;

a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed;

a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components; and

a processing module for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components.

a high speed data router as means for digitally routing respective plurality of module data between said modules.

2. A system according to claim 1, wherein said sub-band conversion module includes an analog-to-digital converter (ADC) for converting the wideband signal from the receiver, a plurality of digital down converters operatively connected to said ADC so as to each generate a sub-band of the digitally converted wideband signal from the ADC, and a data router for outputting the plurality of sub-band signals to said channelizing module.

3. A system according to claim 1, wherein said channelizing module includes a plurality of Fast Fourier Transform (FFT) channelizers operatively connected to receive corresponding ones of said plurality of sub-band signals and thereby generate a corresponding plurality of the complex spectral components, and a data router port for outputting said plurality of complex spectral components to said processing module.

4. A system according to claim 1, wherein said processing module includes a plurality of channel processors operatively connected to said data router so as to

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receive corresponding ones of said plurality of complex spectral components, each of said channel processors being formed so as to determine the presence of signal activity and perform demodulation of at least one signal of interest within the corresponding complex spectral component thereof.

5. A system according to claim 1, wherein said data from sub-band data stream and ~~FFT channelizers~~ channelizer module are operatively connected to subsequent processing modules by high speed data router for connecting said plurality of ~~complex~~ spectral component ~~data streams~~ data to said processing modules.

6. A system according to claim 4, wherein said means for determining the presence of at least one signal of interest includes, within each of said plurality of channel processors:

a First-In-Tap-Out (FITO) delay memory operatively connected to receive and store said corresponding complex spectral component from said data router,

a detection processor for conducting spectral filtering by convolution of said corresponding complex spectral components stored in said FITO delay memory, and for generating spectral activity parameter data on said corresponding complex spectral components based on multiple spectral magnitude running averages on said corresponding complex spectral components,

at least one signal demodulation and recognition processor for filtering and demodulating said corresponding complex spectral components stored in said FITO delay memory based on the spectral activity parameter data generated by said detection processor and further refines and measures signal parameter data; and

a real time controller for controlling the creation and operation of said at least one signal demodulation and recognition processor based on the spectral activity parameter data generated by said detection processor.

7. A system according to claim 6, wherein said means for determining the presence of at least one signal of interest further includes, within each of said plurality of channel processors:

a plurality of signal demodulation and recognition processors for filtering and demodulating said corresponding complex spectral components stored in said FITO delay memory based on the spectral activity parameter data generated by said detection processor.

Sub B8 8. A system according to claim 3, wherein each of said plurality of Fast Fourier Transform (FFT) channelizers includes means for hyperchannelizing the corresponding one of said plurality of sub-band signals in generating said corresponding complex spectral components.

9. A system according to claim 8, wherein said hyperchannelizing means includes a plurality of FFT engines operatively connected to generate complex time-overlapped spectral data.

10. A system according to claim 6, wherein said means for filtering, demodulating, and refining parameter data of at least one signal of interest further includes, within each of said plurality of demodulation and recognition processors:

a two-stage synthesis filter for receiving sub-set of complex spectral components of signal activity from delay-memory storing performing frequency domain filtering, hyperchannel frequency tuning and transforming hyperchannel spectral data into time-domain data;

at least one synthesis filter receiver for signal component filtering and hyperchannel frequency tuning; and

a synthesis receiver controller and demodulation processor for performing a simultaneous plurality of demodulations, and comparing successful demodulation parameters to parameters of signals of interest provided by system control computer.

11. A method for detecting a signal comprising the steps of:

receiving a wideband signal for processing;

converting the wideband signal into a plurality of sub-band signals to be processed;

Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components; and

determining the presence of at least one subset of adjacent spectral components based on multiple running averages and a time delayed average of said plurality of real spectral components.

12. A method according to claim 11, wherein said step of converting the wideband signal includes analog-to-digital converting the received wideband signal, digitally down converting the digitally converted wideband signal so as to generate the plurality of sub-bands of the digitally converted wideband signal, and outputting said plurality of sub-band signals for channelizing.

13. A method according to claim 11, wherein said step of channelizing said plurality of sub-band signals includes Fast Fourier Transform (FFT) processing said plurality of sub-band signals via a corresponding plurality of FFT channels so as to generate a corresponding plurality of the complex spectral components, and outputting said plurality of complex spectral components for determining the presence of at least one subset of adjacent spectral components of signal activity.

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14. A method according to claim 11, wherein said step of determining the presence of at least one subset of adjacent spectral components includes storing said complex spectral components, conducting spectral filter convolution of said complex spectral components, converting said complex spectral components to real spectral components, and generating spectral activity parameter data on said real spectral components.

15. A method according to claim 14, wherein said step of filter convolution of said complex signal samples includes applying a convolution shaping filter incorporating only real weights.

16. A method according to claim 14, wherein said step of filter convolution of said complex signal samples includes applying a Blackman-Harris cosine filter.

Sub B2 A method according to claim 14, wherein said step of generating spectral parameter data includes generating spectral running averages and delayed running averages on said real spectral components.

18. A method according to claim 14, wherein said step of generating spectral parameters on said complex signal samples based on said running spectral averages includes generating parameter data on at least one of frequency, time of start, bandwidth, and signal modulation type of a signal of interest.

Sub B3 A method according to claim 17, wherein said step of Fast Fourier Transform (FFT) ~~processing~~ channelizing processes said plurality of sub-band signals via a corresponding plurality of FFT channels includ~~es~~ing hyperchannelizing said plurality of sub-band signals so as to generate complex spectral components with bandwidths narrower than a signal-of-interest bandwidth.

20. A method according to claim 19, wherein said step of hyperchannelizing said plurality of sub-band signals includes generating complex time-overlapped spectral data.

21. A method according to claim 17, wherein said step of generating spectral magnitude running averages on said complex spectral components includes generating at least a short-term running average, a medium-term running average and a delayed long-term average.

22. A method according to claim 17, wherein said step of generating spectral ~~magnitude~~ running averages on said complex spectral components further includes generating a long-term running average.

23. A method according to claim 17, wherein said step of generating running spectral averages on said real-spectral data includes generating short-term, medium-term and delayed long-term running spectral averages of said spectral magnitudes, and storing said running spectral averages in a buffer memory.

24. A method according to claim 17, wherein said step of generating running spectral averages on said real spectral signal includes generating short-term, medium-term, long-term and delayed long-term running spectral averages of said spectral magnitudes, and storing said running spectral averages in a spectral average buffer memory.

25. A method for processing a complex spectral signal in order to demodulate and recognize a signal of interest, comprising the steps of:

storing a time history of complex spectral signal to be processed in a buffer memory;

selectively outputting a subset of said complex spectral signal stored in said buffer memory so as to represent a spectral band of signal;

receiving said selected spectral band in a two-stage synthesis filter and tuner that center tunes on a candidate signal of interest in said spectral band, filters said spectral band, and outputs a time domain representation of said candidate signal to at least one plurality of synthesis filter receivers;

transforming said time domain candidate signal into complex spectral data via said at least one plurality of synthesis filter receivers;

performing fine tuning, signal component filtering, and time domain transformation of said transformed complex spectral data into transformed signal data;

performing multiple simultaneous demodulations on said transformed signal data via a synthesis receiver controller and demodulation processor in accordance with predetermined signal of interest modulation types, wherein said step of performing multiple simultaneous demodulations includes measuring signal demodulation parameters of said transformed signal data;

scoring said measured signal demodulation parameters by closeness of match to predetermined signal of interest parameters, said predetermined signal of interest parameters specifying threshold scores for measured signal demodulation parameters to be declared successful matches; and

outputting successful signal of interest match scores.

26. A method according to claim 25, wherein said step of selectively outputting a subset of said complex spectral signal includes selecting said spectral band of signal activity subsets based on predeterminedly defined subsets.

27. A method according to claim 25, wherein said step of selectively outputting a subset of said complex spectral signal includes detecting the candidate signal of interest so as to determine a subset of the complex spectral signals with which said subset is associated, and selecting said spectral band of signal activity based on said detection.

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28. A method for demodulating and recognizing a complex spectral signal of interest, comprising the steps of:

accessing said complex spectral signal to be processed stored in a buffer memory;

synthesis filtering of said complex spectral signal so as to generate complex time domain data based on said complex spectral signal;

demodulating said ~~synthesis filtered and~~ complex time domain converted ~~signal;~~ data

conducting further processing of said demodulated signal to determine further signal parameters;

comparing said signal parameters to one or more predetermined signals of interest parameters and computing a weighted score based on parameter matches from said comparing; and

thresholding said score of said parameter matches between said one or more predetermined signal parameters and said demodulated signal parameters, and outputting respective signal of interest scores above threshold as indication of signal of interest recognition.

29. A method according to claim 25, wherein said step of selectively outputting said complex spectral signal stored in said buffer memory includes forming said buffer memory in a First-In-Tap-Out (FITO) configuration whereby complex signal samples with selectively variable delay levels may be generated.

30. A method according to claim 25, wherein said step of outputting signal of interest match scores includes outputting signal demodulation parameters.

31. A method according to claim 25, wherein said step of synthesis filtering said complex spectral signal includes applying a two-stage overlap and add filter.

32. A method according to claim 25, wherein said step of outputting signal of interest match scores includes outputting signal complex time domain data from said two-stage synthesis filter.

33. A method according to claim 25, wherein said step of outputting signal of interest match scores includes outputting refined signal complex time domain data from at least one plurality of synthesis filter receivers.

34. A method according to claim 25, wherein said step of transforming said time domain candidate signal into complex spectral data via said at least one plurality of synthesis filter receivers includes receiving said time domain candidate signal repeatedly in cascaded sequence for further signal data filtering and tuning.

35. A method according to claim 25, wherein said steps of transforming said time domain candidate signal via said at least one plurality of synthesis filter receivers includes receiving and demodulating said time domain candidate signal in cascaded sequence using demodulated output from a first tier synthesis filter controller and demodulator as an input to a second tier synthesis filter receiver and demodulator.

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36. A system for direction finding of a signal, comprising:

a plurality of wideband receivers for receiving input data from a plurality of wideband sensor sources, each of said receivers having a corresponding sensor or antenna source spatially separated from the corresponding sensors or antennas of other receivers;

a sub-band decimation module for each respective receiver, for decimating the plurality of wideband sensor sources into a plurality of sub-band data streams to be processed;

a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band data streams from said plurality of sensor sources into a respective plurality of complex spectral component streams;

a processing module for signal processing said first sensor source plurality of complex spectral component streams, including a means for determining the presence of at least one signal of interest based on multiple spectral running averages and analysis of said plurality of complex spectral component streams;

a direction finding module for determining an angle-of-arrival of the at least one signal of interest based on the analysis of said processing module and said sensor source plurality of complex spectral component streams; and

a high speed data router for digitally routing respective data between said sub-band decimation, channelizing, processing and direction finding modules.

37. A system according to claim 36, wherein said sub-band decimation module includes an analog-to-digital converter (ADC) for converting said plurality of wideband received sensor input data, and a plurality of digital decimators operatively connected to said ADC so as to each generate a corresponding sub-band data stream of the digitally decimated wideband sensor signal.

38. A system according to claim 36, wherein said channelizing module includes a plurality of Fast Fourier Transform (FFT) channelizers operatively connected to receive corresponding ones of said plurality of sub-band data streams and thereby generate a corresponding plurality of the complex spectral component streams.

Sub B A system according to claim 36, wherein said data from sub-band data stream and FFT channeli~~zers~~ 2nd are operatively connected to subsequent processing module~~s~~ by high speed data router for connecting said plurality of ~~complex~~ data ~~streams~~ to said processing module~~s~~.

40. A system according to claim 38, wherein said processing module includes a plurality of channel processors operatively connected to said data router so as to receive corresponding ones of said plurality of complex spectral component streams, each of said channel processors being formed so as to determine the presence of at least one signal of interest within the corresponding complex spectral component streams of first sensor thereof.

41. A system according to claim 40, wherein said means for determining the presence of at least one signal of interest includes, within each of said plurality of channel processors:

a First-In-Tap-Out (FITO) delay memory operatively connected to receive and store said corresponding complex spectral component streams from said data router of said first sensor, and

a detection processor for conducting spectral filter convolution of said corresponding complex spectral component streams stored in said FITO delay

memory, and for generating spectral parameter data on said corresponding complex spectral component stream based on spectral magnitude running averages on said corresponding complex spectral component stream.

42. A system according to claim 38, wherein each of said plurality of Fast Fourier Transform (FFT) channelizers includes means for hyperchannelizing the corresponding one of said plurality of sub-band data streams in generating said corresponding complex spectral component stream.

43. A system according to claim 42, wherein said hyperchannelizing means includes a plurality of FFT engines operatively connected to generate complex time-overlapped spectral data streams.

44. A system according to claim 38, wherein said direction finding module includes means for multichannel calibration of said complex spectral component streams from said plurality of FFT channelizers, and means for determining an angle-of-arrival of the at least one signal of interest based on the analysis of said processing module.

45. A system according to claim 41, wherein said direction finding module includes means for multichannel calibration of said complex spectral component streams from said plurality of FFT channelizers, and means for determining an angle-of-arrival of the at least one signal of interest based on the spectral parameter data generated by said processing module.

46. A system according to claim 43, wherein said means for determining the angle-of-arrival includes means for implementing N-channel interferometric means to determine the angle-of-arrival.

47. A system according to claim 45, wherein said means for determining the angle-of-arrival includes means for implementing a 2-channel commutated algorithm to determine the angle-of-arrival.

48. A system according to claim 45, wherein said means for determining the angle-of-arrival includes means for implementing 3-channel comparative algorithm to determine the angle-of-arrival.

49. A method for direction finding of a signal, comprising the steps of:

providing a plurality of spatially separated antennas;

receiving a plurality of wideband source signals via said plurality of antennas;

decimating the plurality of wideband source signals into a plurality of sub-band data streams to be processed;

Fast Fourier Transform channelizing said plurality of sub-band data streams into a respective plurality of complex spectral component streams;

determining the presence of at least one signal of interest based on spectral signal activity analysis of spectral magnitudes of said plurality of complex spectral component streams of first channel source; and

determining an angle-of-arrival of the at least one signal of interest based on the spectral signal activity analysis.

50. A method according to claim 49, wherein said step of decimating said plurality of wideband source signals includes analog-to-digital converting said plurality of wideband source signals, and generating corresponding sub-band data streams of the decimated wideband source signals.

51. A method according to claim 49, wherein said step of channelizing includes Fast Fourier Transform (FFT) processing said plurality of sub-band data streams to thereby generate a corresponding plurality of the complex spectral component streams.

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52. A method according to claim 49, wherein said step of determining the presence of at least one signal of interest includes delay-memory storing said plurality of complex spectral component streams, conducting spectral convolution of said plurality of complex spectral component streams, and generating spectral parameter data on said plurality of complex spectral component streams of first source signal data.

53. A method according to claim 52, wherein said step of generating spectral parameter data includes generating spectral magnitude running averages on said plurality of complex spectral component streams.

54. A method according to claim 52, wherein said step of generating spectral parameter data includes generating filter data on said plurality of complex spectral component streams using two-stage synthesis filter.

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55. A method according to claim 51, wherein said step of FFT processing said plurality of sub-band signals includes hyperchannelizing said plurality of sub-band signals so as to generate a plurality of complex spectral component streams with bandwidths narrower than a signal-of-interest bandwidth.

56. A method according to claim 55, wherein said step of hyperchannelizing said plurality of sub-band signals includes generating complex time-overlapped spectral data.

57. A method according to claim 49, wherein said step of determining an angle-of-arrival includes multichannel calibrating said plurality of complex spectral component streams, common filtering, and determining an angle-of-arrival of the at least one signal of interest based on the spectral analysis.

58. A method according to claim 49, wherein said step of determining the angle-of-arrival includes implementing N-channel interferometric algorithm to determine the angle-of-arrival.

59. A method according to claim 49, wherein said step of determining the angle-of-arrival includes implementing a 2-channel commutated algorithm to determine the angle-of-arrival.

60. A method according to claim 49, wherein said step of determining the angle-of-arrival includes implementing 3-channel comparative algorithm to determine the angle-of-arrival.

61. A method for detecting a signal originating from a given direction, comprising the steps of:

providing a plurality of spatially separated sources or antennas;

receiving a plurality of wideband source signals via said plurality of antennas;

decimating the plurality of wideband source signals into a plurality of sub-band data streams to be processed;

Fast Fourier Transform channelizing said plurality of sub-band data streams into a respective plurality of complex spectral component streams;

determining an angle-of-arrival of the at least one signal of interest based on the spectral signal activity analysis; and

determining the presence of at least one signal of interest based on direction of arrival activity analysis said plurality of complex spectral component streams.